

family—which may also contain such genera as *Polyplocium* Berk., *Gyrophrangmium* Mont., and *Longula* Zeller.

Since we do not wish to enter such intricate questions of purely gastro-mycete taxonomy as the possibility of maintaining all three last-named genera (which seem to us extremely close to each other), and since our experience with them is relatively limited, we prefer to omit these genera for the time being. However, their close relationship to *Secotium sensu stricto* as well as *Endoptychum* cannot be overlooked.

REVIEW

Comparative Morphology of Vascular Plants. By ADRIANCE S. FOSTER, and ERNEST M. GIFFORD, JR. 555 pp., 213 figs. W. H. Freeman, San Francisco. 1959. \$9.00.

The literature of vascular plant morphology has been greatly enriched by this new textbook by two prominent teachers and researchers at the University of California at Berkeley and Davis. In contrast with other morphology texts that have appeared in recent years, this is a product of men who have devoted their entire careers to the higher plants. As a result, the book is organized in a manner that emphasizes morphological problems of current interest in this area, with subdued treatment of the burning questions of morphology of the early years of this century that are currently only of historical interest. This book is likely to enjoy a long active life as a textbook and reference work, therefore a detailed review seems justified.

A unique feature that sets apart "Comparative Morphology" from earlier textbooks is the organization of material into two sections. In the first part, consisting of six chapters, the principal characteristics of the vascular plants are surveyed in a comparative fashion; in the second part individual chapters are devoted to treatments of the plant groups in systematic sequence. The classification system of Tippe is followed throughout. Extinct groups are treated in an integrated manner alongside their living relatives, but the emphasis is on modern plant types. Detailed descriptive material is not presented for its own sake, but rather as evidence for morphological or phylogenetic conclusions. The detail might be described as interpretative and illustrative rather than as encyclopedic.

The opening chapter tells the beginning student what morphology is all about. There is a discussion of the concept of homology, and of the kinds of morphological evidence that have proved most useful in reconstructing concepts of phylogeny, such as ontogeny, adult form, and the fossil record. The frontiers of modern experimental morphology and morphogenesis are described briefly and some pertinent unanswered questions are posed. The following chapter deals with the overall characteristics of the phylum of vascular plants, giving an outline of a typical life cycle involving an alternation of generations. The existence of apospory and apogamy and the significance of these phenomena on the classical theories regarding the origin of alternate generations is discussed. The phylum is then divided into the usual four subphyla of Eames and Tippe.

Four chapters dealing with the principal areas of morphological investigation are devoted to the vegetative sporophyte, the sporangia, the gametangia, and to embryogeny. Under the heading of vegetative sporophyte are included discussions of the general structure of shoot and root, types of branching, types of leaves, microphylls versus megaphylls, and the phylogenetic origin of leaves according to Bower. The Telome Theory is presented briefly. The area of plant anatomy is entered with a discussion of the problems of classification of tissues and tissue systems. The system of Sachs is presented, and the structure and development of the principal tissues are

described. The chapter closes with a résumé of the historically important Stellar Theory. In this section the uses of the terms dictyostele and eustele are clarified.

The chapter on sporangia describes their function, position, and the organization of sporophylls into strobili in some groups. The structure and development of the two types of sporangia, the eusporangium and the leptosporangium are described, with an excellent series of comparative developmental drawings. The phylogenetic significance of the presence of two sporangium types is discussed. The following chapter on gametangia contrasts antheridia with archegonia in development, structure, and position. The concluding chapter in the first section of the book deals with embryogeny; the parts of embryos, polarity, and the development of the embryo from the zygote. The phylogenetic aspects of the study of embryo development are discussed.

The second section of the book opens with three chapters dealing with the subphyla usually known as the lower vascular plants. The Psilopsida are introduced with an historical treatment of their discovery, followed by synopsis of their classification into two orders and three families. *Rhynia*, *Horneophyton*, and *Asteroxylon* are described. Treatment of these fossils is limited to their general organography and anatomy. *Psilotum* and *Tmesipteris* are covered in much greater detail. Included in the description of the sporophyte structure is a discussion of the interpretation of the nature of the stem appendages, and of the multilocular sporangia found in these genera. The gametophyte generation is discussed in greater detail than is usual in recent texts, incorporating the results of contemporary workers like Bierhorst. The brief section on embryo development is followed by a concluding summary for the group. In the presentation of the details of structure and development of the sporangia, gametangia, and embryo, the earlier introductory chapters on these organs serve as a basis for comparison. In the usual treatment which lacks such introductory chapters, the organs of *Psilotum* must be studied by the beginning student, detached from the reality of the plant world that he knows.

The Lycopsida are treated in similar fashion, but here the living genera *Lycopodium* and *Phylloglossum* are described first, followed by the extinct *Protolopidodendron* and *Baragwanathia*. Then follow *Selaginella*, the Lepidodendrales, *Isoetes*, and the Pleuromeiales. Throughout this chapter much recent research is presented, along with the necessary details of structure and development that are part of the usual subject matter. The chapter on the Sphenopsida follows, using the same pattern of presentation. *Equisetum* is described first in detail, followed by a brief statement on *Hyaenia*, *Sphenophyllum* and *Calamites* conclude the subphylum.

The Pteropsida include the vast majority of living vascular plants and are described under a series of ten chapter headings. The first is a brief introductory description of the group, followed by another chapter which introduces the Filicinae. This chapter includes a very brief discussion of fossil fern foliage in general, and of the Coenopteridales in particular. The taxonomic summary for the ferns is included here, followed by a list of critical areas of morphological study compiled by Bower. The Eusporangiate Ferns and Leptosporangiate Ferns are treated next under separate headings. The latter group, which includes most living fern genera, is treated as a whole in great detail. Excellent series of drawings illustrate the degrees of compounding of fern fronds, variations in venation patterns, variation in sorus structure and position, the development of the sporangium, sporangium structure and various types of annuli, types of sorus in regard to order of maturation of the sporangia. The vast array of stele types found in the ferns is illustrated by an excellent series of photomicrographs. The gametophytes and embryos are described in the same manner as in the lower groups. A section dealing with special problems in fern morphology discusses "phyletic slide" and the relationship between sorus position and phylogeny. Recent work in experimental morphology of the ferns by Wardlaw and others is carefully reviewed. A brief résumé of the problems of fern systematics is included, illustrating the relationship between morphology and phylogeny, between phylogeny and classification. In the course of the systematic treatment, the principal families are briefly described, with fuller treatment of the Marsileaceae.

The Gymnosperms are covered by four chapters. The first is an introductory

conspectus of the group which includes brief treatments of the extinct orders Cycadofilicales, Cordaitales, and Bennettitales. The development and structure of the seed are covered here, including the details of ovule ontogeny, megasporogenesis, the formation of the megagametophyte, pollination, and fertilization. This discussion is followed by a brief statement on embryogeny and seed maturation. The second chapter in this series is devoted to the living cycads and *Ginkgo*. Megasporophyll evolution is illustrated by drawings of various cycads; the cycad life cycle by another series. The details of ovule development and of embryogeny not found in the introductory chapter are included here. The Coniferales occupy the third chapter and are introduced by a systematic treatment of the principal families. This is followed by the usual section on organography and anatomy. Florin's work on Paleozoic and Mesozoic conifers is reported in connection with leaf and strobilus evolution and structure. The life cycle of modern conifers is illustrated by *Pinus*. Included here are the details of fertilization, embryogeny and seed development. Then other conifers are compared with *Pinus*. The final chapter on the Gymnosperms deals with the Gnetales. The structure and life cycle of *Ephedra* are presented in detail, followed by a brief statement of the differences between *Ephedra* and the other genera, *Gnetum* and *Welwitschia*.

The final section of the book consists of two chapters on the Angiosperms. The first of these chapters treats the general structure and evolution of the group, while the second is devoted to the reproductive cycle. Under general structure, leaf morphology is described in detail, with series of illustrations of venation patterns. Stem and root structure are covered more briefly, but a concise statement of modern views on nodal anatomy and its phylogenetic significance is included, as is a brief statement on wood anatomy. The major part of the chapter is devoted to the problems of floral morphology, including theories of the nature of the flower, and the impact of evidence from floral vascular anatomy and from floral ontogeny on these theories. The vast body of work on primitive woody Ranales by Bailey and his associates during the past twenty years is drawn upon for evidence on phylogeny of stamens and carpels. The last chapter on angiosperm reproduction describes microsporangium development and microsporogenesis, the development of the male gametophyte, the ovule, megasporocyte, megasporogenesis, and embryo sac, with detailed discussion of the important types of the latter. The events of fertilization, endosperm development, and embryogeny follow, with a final discussion of seeds and seedlings.

In summary, Foster and Gifford's "Comparative Morphology of Vascular Plants" is an excellent work featuring clear discussions and illustrations, with an organization that should prove a boon to morphology teaching.—SANFORD S. TEPFER, University of Oregon, Eugene.

NOTES AND NEWS

From June through late December, 1959, with the aid of a National Science Foundation grant, DR. FRITZ EHRENDORFER intensified his field and laboratory studies, started several years ago, on the genus *Galium* in the western United States. He returned to Vienna to take up his new duties as Assistant Curator of the Naturhistorisches Museum.

PROFESSOR HERBERT L. MASON, who recently was the recipient of a Fulbright award, will be taking a sabbatical year from the University of California commencing February 1. He will be in residence at the University of Auckland, New Zealand, devoting his time mainly to studies of floristic relations in the Southern Hemisphere.